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(54) POWER PLANTS FOR TRACTIVE VEHICLES

(71) We, PERKINS ENGINES LIMITED, a British Company, of 35 Davies Street, London, W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a power plant for a tractive vehicle having an internal combustion engine.

Vehicles powered by internal combustion engines have in the past been unsuitable for working in relatively poorly ventilated places such as the blind ends of mineshaft workings, because they consume an excessive amount of oxygen to the eventual detriment of their drivers and their own performance, and cause concentrations of exhaust products which may exceed that set down by regulations.

According to the present invention there is provided a power plant for a tractive vehicle including a tractive transmission having a first input drivably connected to an internal combustion engine, at least one additional input drivably connected to a fluid pressure actuator, and at least one output which selectively receives tractive power from the engine through a first drive path of said transmission, or from the actuator, through a second drive path of said transmission, in which the fluid pressure for operating said actuator is supplied from a fluid pressure accumulator, and in which said first drive path includes a first differential gear, a first element of which is driven by the engine, a second element of which transmits drive along the first drive path.

The invention will now be described by reference to the accompanying schematic drawings of which:—

Fig. 1 is a schematic sketch of a power plant for a shovel loader vehicle, and

Fig. 2 is a schematic hydraulic control circuit for the arrangement shown in Fig. 1.

Referring to the drawing, a power plant comprises, a diesel engine 1 driving a first planetary differential gear 2 through its planet carrier 3 and its planet wheels 4. The sun gear 5 drives, through intermediate gearing 6, an air compressor 7 which delivers air for supercharging the engine through a pipe 8. The ring or annular gear 9 of the differential drives the impeller 10 of a torque converter 11 and the turbine 12 of the latter is drivingly connected to a transfer gearbox 13 for transferring drive to an axle level on the vehicle and, if desired, for adjusting the drive ratio. The output shafts 14 and 15 of the transfer gearbox 13 drive second and third planetary differential gears 16 and 17 through the planet carriers 18 and 19, the sun gear 20 and 21, in each case, being connected to the respective axle differential 22 and 23 of the two axled vehicle through appropriately universally-jointed shafts 24 and 25, the latter being the outputs from the power plant.

A hydraulic pump 26 is driven at engine or other speed from the front of the engine and a second hydraulic pump 27 is driven at the ring gear 9 speed by an external gear 28 meshing with a pump drive pinion 29. A hydraulically actuated brake is provided somewhere in the drive line between the converter turbine 12 and the gears 16 and 17. For convenience this is represented as brake 30. Two hydraulic motors 31 and 32 are drivingly connected to the ring or annular gears 33 and 34 of gears 16 and 17 by virtue of meshing engagement of their pinion gears 35 and 36 with respective external gears 37 and 38 on the rings 33 and 34.

The drive line from the engine 1 through the first differential gear 2, torque converter 3, gearbox 13 to the shafts 14 and 15 constitutes a first drive path and the drive from the motors 31 and 32 to the differential gears 16 and 17 constitute second and third drive paths, respectively.

Fig. 2 shows the hydraulic control ar-

rangement for the vehicle having a power plant as shown in Fig. 1.

The pump 26 supplies hydraulic pressure fluid from a reservoir 40 to an accumulator 41 and a control valve 42. A pilot operated relief valve 43 is provided to allow pressure to be maintained at a predetermined level in the accumulator. The control valve 42 is a two port two position manually actuated valve which is spring loaded to the "no-flow" position and has an overridable detent for holding it in the "flow" position. The valve 42 permits flow of pressure fluid to the two motors 31 and 32 and to an actuator 44 for energising the brake 30. Thus, when the ring gears 33 and 34 are driven by the motors 31 and 32 the planet carriers 18 and 19 are prevented from rotating by the brake 30.

A second hydraulic circuit is supplied by the pump 27 which feeds a control unit 45 consisting of a bank of manually operated control valves for controlling various rams and possibly other hydraulic motors. In particular the unit 45 is required to control a double acting ram 46 which alters the attitude of a bucket mounted, at the front of the vehicle, on lift arms which are themselves capable of being elevated by a single acting ram 47.

The procedure involved in operating the machine incorporating the invention is for the driver to lower the bucket by using the control unit 45, and driving the vehicle forward through the first drive path so that the bucket engages the material to be loaded. Thereupon the differential diesel engine, which is the name given to the engine, differential compressor and torque converter assembly, is prevented from driving the vehicle by the application of brake 30 whilst the vehicle drive is taken up by the hydraulic motors 31 and 32 through the second and third drive paths, the planet carriers 18 and 19 and shafts 14 and 15 being held stationary by the brake 30. The hydraulic motors 31 and 32 are powered solely by the accumulator 41. The vehicle will only advance very slowly for a small distance into the material to enable the bucket to be fully charged as it is tilted back on the end of the lift arms. While the accumulator powers the vehicle forward the engine at a reduced power setting drives pump 26, thereby delivering most of its power to the pressure circuit which feeds the hydraulic actuators. Thus the greater part of the deliberately reduced engine power is used to effect relatively quick operation of the digging and lifting operation at this time.

When the bucket is full and lifted the brake 30 is released and the motors 31 and 32 are isolated consequently locking them hydraulically against rotation. The vehicle drive is taken up by the engine, the motors 31, 32 providing the reaction for the planetary gears 16 and 17. The oil in the secondary circuit which does not require power at this time, is left to circulate under no pressure thereby consuming minimal power. The circuit which includes the accumulator 41 however is now under pressure and is charged by the pump 26 whilst the vehicle is performing a carrying operation with the material contained in the bucket. When the accumulator is fully charged the pressure is maintained by a pressure relief valve 43 but it can be arranged for a pilot operated shut-off valve to be substituted for the relief valve so that the pump 26 discharges at zero pressure when the accumulator is fully charged.

The invention enables minimal consumption of air by the engine when working in relatively poorly ventilated regions such as the blind ends of mineshaft workings.

The arrangement confers additional advantages in that the alternative transmission powered by the accumulator through hydraulic motors can be arranged to develop a very large forward force for engagement of the bucket with the material. If necessary this forward force can exceed the torque developed by the power plant by up to 100% but in this case it is advisable to protect the elements of the main transmission by installing brakes on shafts 14 and 15 or by locking planet carriers 18 and 19 to adjacent stationary housings. The energy available in the accumulator would be used as a very high force over an extremely short distance.

It is also envisaged that the control for operating the bucket and lift arm mechanism could be linked to control valve 42.

During the period of maximum tractive effort the wheels are driven by the hydrostatic system. Because the flow rate is small the motor supply may be heavily throttled, thus automatically suppressing any tendency to wheel slip and preserving the tyres. Alternatively a flow sensitive valve may be inserted in the line such that it shuts off the pressure from the accumulator if the flow exceeds a particular value due to slippage.

WHAT WE CLAIM IS:—

1. A power plant for a tractive vehicle including a tractive transmission having a first input drivably connected to an internal combustion engine, at least one additional input drivably connected to a fluid pressure actuator, and at least one output which selectively receives tractive power from the engine through a first drive path of said transmission, or from the actuator, through a second drive path of said transmission, in which the fluid pressure for operating said

actuator is supplied from a fluid pressure accumulator, and in which said first drive path includes a first differential gear, a first element of which is driven by the engine, a second element of which transmits drive along the first drive path.

2. A power plant as claimed in claim 1, in which said accumulator is charged by a fluid pump driven by the engine.

3. A power plant as claimed in claim 2, in which a third element of said first differential gear transmits drive to a supercharger for the engine.

4. A power plant as claimed in claim 2 or 3, in which the first drive path includes a torque converter the impeller of which is driven by said first element of the first differential gear.

5. A power plant as claimed in any preceding claim including a second differential gear common to said first and second drive paths, in which a first element of said second differential gear is drivingly connected to the engine, a second element is drivingly connected to the fluid actuator and a third element is connected to the output.

6. A power plant as claimed in claim 5, in which a second output from the transmission is provided which selectively receives tractive power from the engine through said first drive path or from a further actuator through a third drive path of said transmission.

7. A power plant as claimed in claim 6 including a third differential gear common to said first and third drive paths in which a first element of said third differential gear is drivingly connected to the engine, a second element is drivingly connected to the further fluid actuator and a third element is connected to said second output.

8. A power plant according to any preceding claim in which the fluid actuator or actuators is a hydraulic motor.

9. A power plant as claimed in claim 3 and any one of claims 4 to 8 when appended to claim 3, in which said first differential gear is a planetary gear in which said first element is the planet carrier, said second element is the annulus, and said third element is the sun gear thereof.

10. A power plant according to claim 9, in which said second element of the first differential gear also drives a further pump for providing a source of pressurised fluid for vehicle services.

11. A power plant as claimed in claim 5 or any one of claims 6 to 10 when appended to claim 5, in which said second differential gear is a planetary gear in which said first element is the planet carrier, said second element is the annulus, and said third element is sun gear thereof.

12. A power plant as claimed in claim 7 or any one of claims 8 to 11 when appended to claim 7, in which said third differential gear is a planetary gear in which said first element is the planet carrier, said second element is the annulus, and said third element is the sun gear thereof.

13. A power plant as claimed in any preceding claim in which each of said drive paths is selectively lockable.

14. A power plant as claimed in claim 13, in which said first drive path is lockable by means of a hydraulically operable brake which is applied automatically when the fluid actuator or actuators are supplied with pressurised fluid.

15. A power plant substantially as hereinbefore described with reference to the accompanying drawings.

16. An earthworking vehicle including a power plant as claimed in any preceding claim and having hydraulically operated earthworking services.

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1308318 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

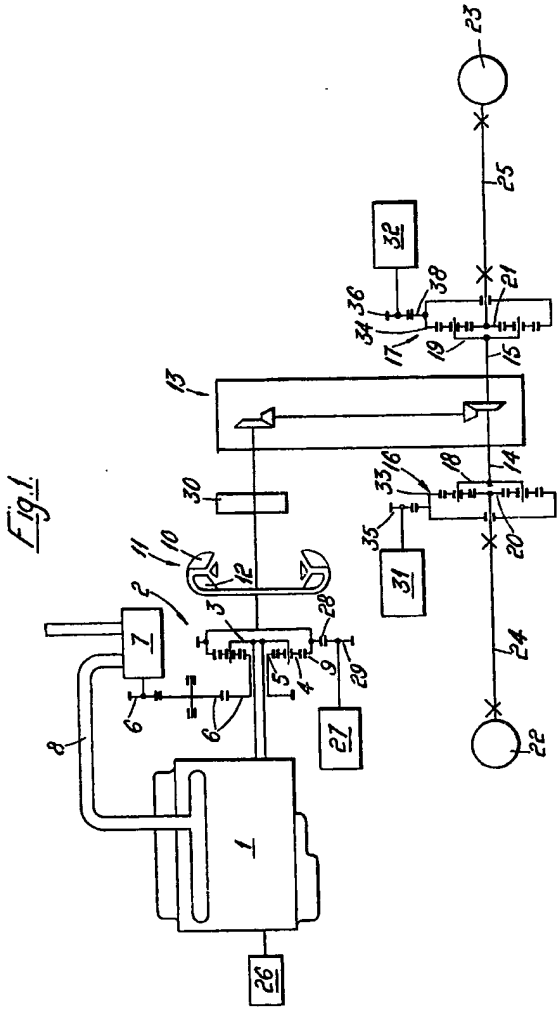

Fig.1.

1308318 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

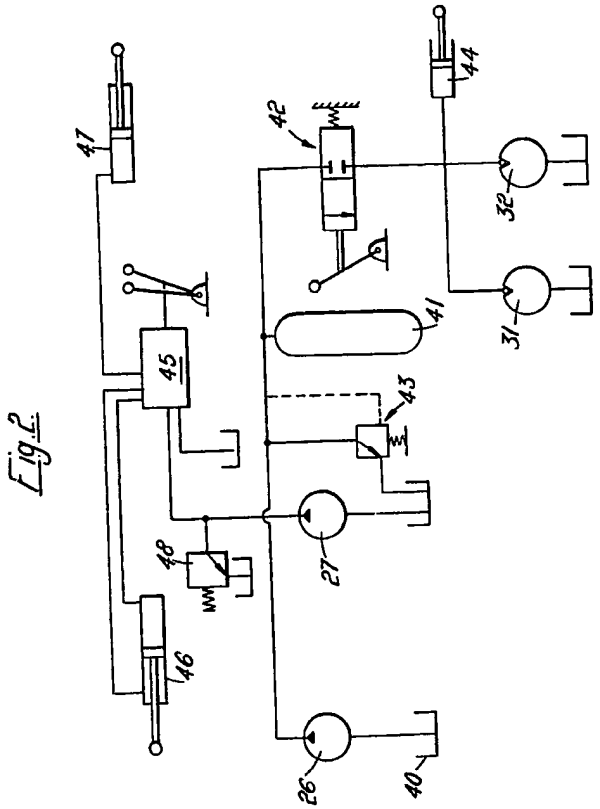

Fig.2.